in the Catalogue as to what he has done with it, I can only suppose that it is a species which he omitted to label when described, and which has consequently become the type of some species in another genus.

The following group is so close to *Azelina* that it may save the multiplication of synonyms to refer to it here.

Paragonia deustata.

Paragonia deustata, Felder, Reise der Nov., Lep. v. pl. cxxiv. fig. 8 (1876).

Chili.

Paragonia subornata.

Macaria ?? *subornata,* Walker, Cat. Lep. Het. xxvi. p. 1644 (1862).

Monte Video (*Darwin*). Type B.M.
Nearly allied to the preceding species.

VI.—*Supplementary Notes on the Flints and the Lithological Identity of the Chalk and Recent Calcareous Deposits in the Ocean.* By Surgeon-Major Wallich, M.D.

It may be in the recollection of those who have read my former observations on the subject * that, in default of any available direct means of proving the lithological identity of the chalk and calcareous deposits of the Atlantic and other oceans, I was obliged to rely chiefly on collateral evidence in support of the view I advocated—namely, that the extraordinary contrast between the percentages of silica, supposed to characterize these two formations, does not in reality exist, but is altogether based on the fallacious standard employed in making the comparison. I maintained that the nearly total absence of disseminated silica now observable in the Chalk is not due to an almost infinitesimal quantity of that substance having originally been present in it when it rested as mud on the Cretaceous sea-bed, but to the fact of nearly the whole of the silica it then contained having been then and there eliminated from it through the agency of colloidal sponge-protoplasm. For a like reason I contended, that the large percentage of silica now met with in the surface-mud of the recent calcareous areas does not furnish a trustworthy index to the percentage which would be found were it possible

* "A Contribution to the History of the Cretaceous Flints," Quart. Journ. Geol. Soc., Feb. 1880; and "On the Origin and Formation of the Flints of the Upper or White Chalk," Ann. & Mag. Nat. Hist., Feb. 1881.

to obtain for analysis a specimen of the consolidated stratum resting at some depth below the surface, inasmuch as the excess present in the immediate surface-layer (*from which alone all our information has heretofore been derived*) represents, in reality, the aggregate contributions extracted from each freshly-deposited layer as it became gradually submerged beneath the layer that succeeded it. And, lastly, stating the case in another form, I concluded that, were it possible under existing conditions to compare with a portion of chalk a portion of recent calcareous mud obtained from a considerable depth * below the surface of the sea-bed, there would in all probability be no material difference in the relative percentages of silica derived from the two sources.

It subsequently occurred to me, however, that if my hypothesis concerning the causes which lead to the stratification of the flints is correct, the fossilized organic contents, so frequently met with in certain hollow nodules, would at once supply the requisite data for determining the relative quantities of silica in the two formations, especially as the alleged great excess of silica in *one* of these is so pronounced as to render an approximately accurate quantitative analysis—such as I might myself carry out—sufficient for the purpose contemplated.

The line of inquiry I marked out in order to put my hypothesis to the test of actual experiment was, to ascertain, if possible, what constant distinctions are traceable between the contents of those nodular cavities that have never, since their consolidation, been so perfectly closed as to cut off all communication whatever between their contents and the medium surrounding the nodules, and the contents of those cavities that have remained hermetically closed since that critical stage in their history when they became sufficiently consolidated to put every subsequent change in the lithological combinations formed amongst the enclosed materials beyond the pale of any supplementary accessions of materials from without, or any transfer of the originally included materials from within.

Then, taking as my point of departure the fact alluded to in my last paper on the flint question †, namely that the contents of hermetically-closed nodular cavities consist of absolutely intact portions of the organic material, *and even of the water*, of the ancient Cretaceous ocean, around which the highly

* By immediate surface-layer I mean from 6 inches to probably a foot and a half, beyond which there is no sufficient proof that any dredge, sounding, or probing-machine has ever yet penetrated.

† Ann. & Mag. Nat. Hist., Feb. 1881, pp. 178 and 201.

contractile, but as yet unconsolidated, nascent nodules had closed in so as to completely imprison them, I argued as follows:—Inasmuch as the stratified flints were formed at the immediate surface of the ancient sea-bed, from an already highly saturated combination of sponge-silica and sponge-protoplasm *, the portion of organic débris entrapped within the as yet unconsolidated masses of nascent flint *must*, in like manner, have been derived from the immediate surface-layer; and consequently, since the nascent nodules were, under the conditions specified, incapable of appropriating more silica from any source, or of transferring any of their own silica beyond their own boundary walls, whatever quantities of silica and carbonate of lime were originally present in the imprisoned masses, must have remained locked up, from the Cretaceous period down to our own time, in the cavities in which we now find them.

It will be seen hereafter that the examination made by me, in pursuance of the plan thus sketched out, of a very extensive series of carefully selected nodular flints, fully substantiates the main conclusions at which I had previously arrived on the basis of collateral evidence only.

As regards the abstract possibility of the walls of the nodular cavities (reduced as they occasionally are to a thickness not exceeding a third or even quarter of an inch †) being sufficient to prevent the dialytic translation of any of the mineral substances held in solution within them, it is, I presume, almost unnecessary for me to offer any further proof than the fact, well known to every mineralogist and chemist, that minute quantities of fluid have continued pent up in quartz, for periods, and under pressures, far exceeding those we have now to deal with. But, even apart from this fact, the condition in which we find the contents themselves, and the appearance presented by the perfectly unbroken walls of flint, tend to prove that no such dialytic translation of material has, or indeed could have, taken place. On this point, however, I shall have something more to say further on.

It has already been stated that my observations serve to establish the lithological identity of the ancient and recent calcareous formations. But they do more than this; they lend the strongest support to the view, if they do not absolutely prove, that the final stage arrived at, in the consolidation of the contents of the nodular cavities, is wholly dependent

* Quart. Journ. Geol. Soc., Feb. 1880, pp. 68–91.

† I mention these, not as indicating thicknesses present in the nodules the contents of which I have selected for analysis, but merely as the minimum compatible with safety.

on the presence, or exhaustion, of the water of the ancient ocean which was imprisoned along with the solid materials. It is upon the exhaustion of this water that each one of the various transitional stages of metamorphism in the materials —ranging from a partial replacement of the carbonate of lime by silica, to the production of a form of chert so homogeneous and white as closely to resemble porcelain—is brought to a final standstill; whilst between these two extremes is to be met with every intermediate stage of (what I may describe as) collateral metamorphism, including the production of chalcedony or jasper through an occasional excess of alumina and iron, of fibrous as well as granular silica, and, finally, of the purest crystals of quartz, crystallized out of the last expiring remnant of water holding in solution the last residuary particles of silica.

Of each and all of these transitional varieties of the material I have preserved representative specimens; and it is no exaggeration to say that each time I look at them some new fact seems to reveal itself in their wondrous history.

On the present occasion I will content myself with drawing attention to two of the facts that have been elicited. The first is, that in those nodular cavities in which the imprisoned contents have not already been reduced to an anhydrous condition—putting one in mind of our satellite the moon, without atmosphere, without vapour, without even a ray of the reflected light she receives—the whole of the changes above enumerated can be distinctly noted *as being either still in progress* or as having been cut short by the exhaustion of the water, to which alluusion has just been made.

The circumstances connected with the second fact on which I propose to touch, demand a few words of explanation. This I have all the more pleasure in supplying, since it enables me to make the interesting announcement, that the still mysterious little organisms to which I gave the name of coccospheres (discovered by me in 1860, amongst the rest of the organic débris*, in soundings in the North Atlantic), have very recently, and for the first time, been detected by Mr. J. T. Young in a fossil state. Mr. Young has already detected them in the Chalk series from various localities in the neighbourhood of London. They have, up to this date, been found by him "in the Chalk from Marlow, Pinckney's Farm (near Maidenhead), Charlton, Gravesend, the Grey Chalk from the boring at Meux's brewery, and the Glauconite beds (Upper

* As stated in a paper on the Polycystina in the Quart. Journ. Microscop. Soc. for July 1865, I discovered living coccospheres in abundance in the tropical seas on both sides of Africa in 1857.

Greensand) at Folkestone, but, most abundantly, in Grey Chalk from the Finchley Boulder-clay."

Mr. Young, knowing the interest taken by me in the matter, was good enough to acquaint me with his discovery soon after making it in April last, and to increase the obligation thus rendered, by presenting me with illustrative slides and specimens of the Chalk itself, intimating at the same time that I was at liberty to make any use I liked of the information. He thus enabled me not only at once to verify his observations, and, under the salutary stimulus afforded by his discovery, to detect coccospheres in two or three specimens of chalk I had by me, but, what was of still greater interest to me just now, owing to its opportuneness, to detect *silicified* coccospheres in the cavities of hermetically closed nodules obtained direct from the Upper Chalk, and also in a number of similarly closed hollow flints obtained, in the usual rolled and weathered condition, from neighbouring gravel beds!

It is at this point that the history of these still mysterious little structures becomes so intimately connected with the flint question as to warrant my laying greater stress on it than I should otherwise have done; for not only does it add another powerful link to the chain of evidence regarding the mineral identity of the chalk and recent calcareous deposits, but it conclusively attests the accuracy of the statement made by me when I first figured and minutely described the coccospheres *—namely, that, in common with the detached appendages of these organisms called "coccoliths," the *cell-wall of the coccosphere is consolidated by carbonate of lime* †, and hence, when not silicified, exhibits by polarized light the well-known distinctive cross. I may take this opportunity of mentioning that, as some doubts have been expressed as to the correctness of my view regarding the calcareous nature of the cell-wall of the structures in question, I have during the past twelve months carefully repeated my examination of them, and am now in a position to reassert its strict accuracy in every particular.

I have spoken of the lithological identity of the ancient

* "On some novel Phases of Organic Life at Great Depths in the Ocean," Ann. & Mag. Nat. Hist., July 1861.

† It is a remarkable fact, also pointed out in the paper just named, that I had never then (and I may here add that I have never since, either during my cruise in the North Atlantic in 1860 or during my subsequent examination of *preserved* specimens) observed a single collapsed or crumpled specimen. In the large oblong coccospheres found by me, in 1857, in the tropical ocean on both sides of Africa, one end of the structure "dehisces," as if truncated; but I do not recollect having ever seen it crushed or collapsed.

and recent calcareous formations. It should, however, be clearly understood that this term is only applicable to them both, as they undoubtedly present themselves to our notice, in connexion with occasional peculiarities depending upon conditions with which we are as yet very imperfectly acquainted. For example, the term "*Globigerine areas*" has been employed by more than one eminent writer as synonymous with an ideal standard of what recent cretaceous mud ought to be like. It is not, however, in the purest Globigerine areas that the deposit approaching nearest to the Upper or White flint-bearing Chalk is being deposited. But that a true flint-bearing cretaceous rock is being very generally deposited over certain areas of the ocean, differing from it perhaps as much, *in colour only*, as the latter differs from the Grey, but nevertheless lithologically identical with it, is, I am inclined to believe, quite certain. On the other hand, grave objections have been urged against this view on purely palæontological grounds, which may be as insuperable as the authority is high of the eminent geologists who entertained them. But having had some practical experience in deep-sea exploration, and being aware of what has been done in this direction by others during the last ten or twelve years, I cannot help considering it somewhat premature to affirm—because "not a single one of the characteristic Cretaceous genera of Mollusca, such as *Ammonite*, *Baculite*, *Belemnite*, &c., has been brought to light in the Globigerine areas, and nothing to indicate that the Cretaceous formation (speaking in a geological sense) is going on anywhere with that sort of persistency which is inferred by" some *—that the attainment of this or equivalent palæontological evidence is impossible. The fact is that no really appropriate means have heretofore been devised and perseveringly employed for determining the question; and, looking at it from a less debatable point of view, the most that can be said of the opportunities heretofore available for the detection of some of the missing palæontological links is—that the likelihood of their proving successful stands on a par with an attempt (were such to be indulged in by some zealous naturalist) to determine the precise nature and scope of the European marine fauna by dropping a thimble at every mile or two miles on the bottom of the area known as the British Channel.

It will have been observed from the foregoing remarks that I have adopted as the basis of my conclusions the fact that, since the substance of the chalk itself furnishes un-

* Extract from a letter of Sir Charles Lyell's to the author, dated January 24th, 1870.

questionable proof that the quantity of silica *now* present in it is so small as hardly ever to exceed 3 per cent., the close approach to uniformity between the demonstrable percentage of silica in the surface calcareous mud of the existing sea-bed and the *now* also demonstrable percentage in the contents of the hermetically closed nodular cavities (which must in like manner have been derived from the immediate surface mud of the cretaceous sea-bed) warrants the inference that the relative percentages in the equivalent "horizons" of the two formations are equal, and hence that this uniformity must, according to all reasonable probability, extend to every subjacent horizon.

In order to substantiate this inference, however, it is indispensable that some distinct and constant difference should be shown to exist between the mineral constitution of the material contained in such flint-cavities as have from the beginning remained perfectly closed, and those which have never been completely so. I may state that within the past six months I have carefully examined at least two hundred specimens of each kind and that, so far as the experience thus acquired enables me to speak with confidence, I am quite unaware of a single example in which the original organic carbonate of lime of the Foraminifera and other débris obtained from the closed cavities, has not been more or less completely, but never completely, replaced by the organic silica. I say never completely replaced because I have never yet seen any portion of the original calcareous material that yielded otherwise than very partially to the action of hydrochloric acid. As a rule the entire contents, without exception, are composed of chert —that is to say, of a chemical combination of carbonate of lime and silica in every proportion, from the state of nearly pure silica on the one hand, to the perfect form of chert already described by me at p. 49, *antè*, on the other; whilst in the contents of the only partially closed cavities, and notably in the deep external furrows present in some nodular flints, the silicification would seem rarely, if ever, to have proceeded to the same extent; and we find (what is never found in the perfectly closed cavities) calcareous organisms altogether unmetamorphosed. This is most strikingly manifest in the case of "coccoliths," and, as I have recently discovered, of the coccospheres, every one of the latter obtained from the closed cavities being, without exception, silicified to such a degree as to remain perfect in all their details after subjection to strong hydrochloric acid. The explanation of this is sufficiently obvious. In the one case the siliceous materials and included portion of colloidal protoplasm have had an unlimited quantity of carbonate of lime in the surrounding matrix to work upon, and an unfettered access to water. Hence they have virtually been in the same position they would have occupied if simply imbedded in the chalk itself, where they occur in multitudes.

In the other case the silica, carbonate of lime, and protoplasm are imprisoned within a closed wall of adamant, and have had to come to terms as best they could without the least extrinsic aid or interference.

It is moreover specially deserving of note that the occurrence of *silicified* coccospheres in the closed cavities furnishes the strongest presumptive evidence that they and the materials associated with them are of extrinsic origin, and are not, as it were, effete or residuary products derived from the nodular mass itself. For, obviously, these extremely minute structures would have been the first to succumb to silicification by replacement, and consequently to absorption and obliteration in the substance of the flint, had those now found in the nodular cavities ever formed part of it.

Another point upon which I lay great stress is the unmistakable evidence, already alluded to, of the various changes that take place amongst the imprisoned materials, continuing in operation, in certain cases, to the present day.

It is an important circumstance that, in such closed cavities as contain a large proportional quantity of water, the advance from the initiatory condition of the component materials associated with it *is at its minimum*—an apparently paradoxical assertion in view of what was said a few lines back, as to water being the determining agent in the chain of metamorphism under notice. It is, however, no paradox; for what happens is, that the larger the relative quantity of water the larger is the quantity of silica maintained in solution, and the less tendency is there in it to supplant the coexistent carbonate of lime. In this wise the carbonate of lime, obviously the more yielding of the two mineral elements throughout all these operations, is left alone for a longer period.

It is a very remarkable fact, moreover, that the water-containing cavities seem to be most common, and the quantity of water greatest, in those flints which have been obtained from gravel beds, and must therefore, during a very considerable period of their incarceration, have been subject to the mighty turmoil of some ancient coast-line. Unfortunately I have as yet neither had the time nor the appliances for analyzing this water. I can, however, state that it is perfectly clear and limpid when allowed to settle, has no perceptible saline taste, and evaporates with extraordinary rapidity on being laid bare to the atmosphere.

One of the conclusions I draw from the data afforded, is that the period at which perfect consolidation of a given stratum of flint takes place (leaving out of consideration at present the fissure-flint, which involves widely different issues, of which I may have something to say on a future occasion) is contemporaneous with the consolidation of the stratum of chalk underlying it; whereas the period of ultimate consolidation of the contents of the closed cavities would appear to be indefinite. Some have apparently become consolidated at the same time as the enclosing flint nodule. This would seem to have occurred in those cases in which there is no trace of cavity left—the materials, entrapped as almost solid lumps of mud, with no more water than was just sufficient to keep them in a stiff paste, having filled up the entire space and become finally merged as a solid core in the substance of the surrounding wall of flint. In other cases the materials would appear to have become consolidated after an indefinitely lengthened term, leaving central cavities devoid of fluid, and bounded either by a glistening mass of minute quartz crystals or of delicately mamillated chalcedony with an intervening layer of reddish or greenish jasper between the crystalline layer and the substance of the flint. Where water is present in a residuary cavity, so is some remnant of unconsolidated material. Of course, in the whole of the examples of which I have spoken in this paper, I have purposely left out of sight such nodules as have formed around a distinct portion of sponge-structure. They have a perfectly distinct history of their own.

I would here allude to an additional proof I have to offer of the contents of the hermetically closed cavities being in the strictest sense "*inclusions*," as distinguished from any solid material that may have formed part of the nascent flint mass itself. It consists in the important fact that, but for the superior cohesiveness (the "*idio-attraction*" of Mr. Graham) of the nascent nodular masses, and their stubborn refusal to mix with water, in no instance in which free water had been admitted along with solid material in any considerable quantity, as compared with the internal area of the cavities, would the finally consolidated mass be found (as it constantly is found, whether in a finely or coarsely granular state, or a compact and solid cherty mass) resting quite loosely within the cavity like the kernel of a hazelnut within its shell. Under no other possible or even conceivable condition than those resulting from the hermetical closure of the cavities from the beginning, would the imprisoned water have remained to this day unexhausted, even assuming what I believe to be impossible—that the said water, instead of having been directly obtained in the first instance from the Cretaceous ocean itself, had originally formed part of the "combined water"* of the nodule when in its still colloidal nascent condition. On the other hand, it is by no means improbable that, in every case, a limited portion of the contents of the nodular cavities has, during the yet unconsolidated state of the nodules, been expended in thickening, from within, the cherty lining of the interior of these cavities. But it is manifest that, although this would to the same extent diminish the quantity of included material, it could not exercise any material effect on the relative percentages silica and carbonate of lime left within the cavity.

Lastly, where any channel of communication existed between the interior of the consolidated nodular cavities and the outer world, through which water from without could have penetrated, it is evident that in the case of flint nodules obtained from gravel beds, or where a stratified layer of flints had been left exposed to atmospheric influences, such water must have carried along with it foreign substances in a minute state of division or in solution, and that these must have produced a distinctly observable effect upon the imprisoned masses. Under these circumstances, moreover, a means of egress as well as ingress would have been established, so as to permit of the escape of portions of the material from the interior of the nodular cavities, as well as the entrance of some of the materials from without—a state of things which could not for a moment deceive any experienced observer.

It will be seen that in my analysis I do not pretend to have arrived at strict accuracy, but have rested satisfied with supplying an approximate index to the relative proportions of *soluble* and *insoluble* materials only. It must be borne in mind moreover that, on the one hand, there is no question just now pending as to the quantity of residuary substances known to exist only in extremely minute proportions in the materials under examination, and, on the other hand, that silica and carbonate of lime constitute, as a matter of fact, at least from 90 to 95 per cent. of the mass. The point to be determined, therefore, is not whether more or less than from $\frac{1}{2}$ to 3 or, at the utmost, 4 per cent. of the silica present in the chalk is doubled, trebled, or even quadrupled in the material from the flint-cavities, but whether the silica present in the latter corresponds approximately with that met with in the calcareous mud of the existing sea-bed †.

* See a paper "On the Properties of Silicic Acid," by the late Mr. Graham (Proc. Roy. Soc. for June 1864).

† The analysis given below was made at my request, in February 1880, by Mr. W. F. Ward, of the Royal School of Mines. It is intended to

Now the quantity of silica in the recent mud has been variously estimated at from 20 to 30 per cent. of the mass, the carbonate of lime at from 50 to 60 per cent. All I now profess to accomplish is—to show *that my results*, as deducible from analyses of the material obtained from hermetically closed cavities, *correspond very much more closely with the percentages found in the recent calcareous mud than those erroneously supposed* (as I contend) *to represent the original quantity of silica contained in the chalk.* That I have done this much will, I think, be freely conceded. But in order still more firmly to establish my position, I must have such a detailed qualitative as well as quantitative analysis made of the quantity of carbonate of lime which is undoubtedly locked up in the cherty portion of the contents, and rendered temporarily insoluble by its combining with the silica to form the large residue included in my analysis under the head of *insoluble* matter.

There is another point that demands explanation. I have had to balance the percentages of material, as closely as I considered justifiable in the absence of further analytical data, in quite an opposite direction—that is to say, by showing that this large insoluble residue is not pure silica but *chert*, and that the chert found in the hermetically closed nodular cavities, and, indeed, in "the flint" generally, is here as elsewhere a compound of organic silica and lime, which unite, where an organic colloid is present, in almost indefinite proportions. Now the silica in the recent calcareous mud does not exhibit any appreciable trace of intermixture with carbonate of lime. In the contents of the nodular cavities the captive silica and lime have, during the lapse of ages of undisturbed seclusion (the existing conditions being precisely those most likely to favour their union), become closely combined,—the point at which any further combination between the materials was arrested having been the point at which they became *anhydrous*.

The chert of the flints is nearly altogether insoluble in hydrochloric acid. The most perfect form of chert met with

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show the percentage of *silica* in seven samples of chalk which were taken by me at various levels from the face of a lofty cliff in one of the pits at Charlton:—

	per cent.
A	0·57
B	0·50
C	0·49
D	0·48
E	0·64
F	0·95
G	0·59

n the cavities is not soluble even in boiling nitrohydrochloric acid. Hence it appears to be not a mere mechanical combination of the lime and silica which produces the extreme hardness, whiteness, and homogeneousness of the porcelain-like form to which I have already called attention, but a truly chemical union between the two substances.

Under these circumstances I leave the analysis to speak for itself. At the same time I annex to it a purely arbitrary and provisional computation of the probable *average* amount of carbonate of lime that had entered into combination with the silica to form the large *insoluble* residue. One third may be too high or too low an estimate; but I am inclined to think it will eventually prove not very far wide of the mark. On these grounds I submit that I have made good the statement with which I opened this paper—namely, that the ancient and recent Cretaceous formations are lithologically identical.

It will be noticed that I have deemed it better, for the present at least, to adhere to the term "*silicification*" than to have continually to repeat the expressions *conversion into chert*, or flinty chert, or cherty flint, as the case may be—since one and all of these would, for the reasons already assigned, be too indefinite to serve any useful purpose. Our scientific vocabulary is already extensive enough to discountenance the addition to it of such a word as *chertification*. At the same time, I confess I do not quite see my way to avoiding it.

In selecting specimens of materials for analysis I have used every available precaution to ensure their having been obtained from really hermetically closed nodular cavities, and being in the condition best fitted to furnish trustworthy results.

The total number of specimens analyzed by me is ten. Of these, six were extracted from the cavities of nodules obtained from gravel beds and four from the cavities of nodules obtained from the Upper White Chalk. Two of those from the gravel beds, however, were analyzed, not for the purpose of comparison, but with a view to determine the source of their exceptionally rich sulphur tint. The number represented in the analysis is therefore reduced to eight.

Taking into account 3 per cent. as the approximate quantity of carbonate of lime locked up in the *insoluble* residues, and adding it to the *soluble*, we have:—

				per cent.	per cent.	
From the Upper Chalk.	No. 1, 3, 4, 9	Average.	Soluble in acid . .	$52\frac{17}{24}$	$68\frac{34}{72}$	carbonate of lime.
			Insoluble in acid .	$47\frac{7}{24}$	$31\frac{38}{72}$	silica.

From the gravel beds.	No. 2, 5, 8, 10	Aveage.		per cent.	per cent.
			Soluble in acid ..	$44\frac{55}{48}$	$63\frac{13}{126}$ carbonate of lime.
			Insoluble in acid	$55\frac{29}{84}$	$63\frac{113}{126}$ silica.

It only remains for me to express my hope of being able, on a future occasion, to enter more fully into the various remarkable changes which are observable in the materials enclosed within both the perfectly and the only partially closed nodular chambers. I also hope to be able to furnish a series of perfected analyses of the solid materials, and of that most interesting portion of the sealed-up nodular contents—namely, the water handed down to us from that grand old ocean,—all these details being inseparably connected with the flint-question as a whole.

June 16, 1881.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

May 11, 1881.—Robert Etheridge, Esq., F.R.S., President, in the Chair.

The following communications were read:—

1. "Notes on the Fish-remains of the Bone-bed at Aust, near Bristol, with the Description of some new Genera and Species." By James W. Davis, Esq., F.S.A., F.G.S.

The fossil fishes described in this paper are from the Rhætic bed at Aust Passage. The stratum containing the fish-remains is rarely more than 9 inches thick, often considerably less, and is composed of rounded masses of hardened clay or marl, which, at the time of their deposition, were soft enough to receive the impressions of the coprolites and fish-remains. There are large numbers of coprolites and bones of fishes, as well as some remains of Saurians, mingled with each other indiscriminately. The fishes belong to the orders Plagiostomi and Ganoidei, some of the former being of considerable size. It is inferred, from the intermixture of Saurians and fishes, that the deposit is the result of shallow water existing near land, in which the fishes lived and the Saurians occasionally disported themselves.

Besides the fossil remains of the animals which lived during the deposition of the Aust beds, there are also others which appear to have been derived from the Mountain Limestone and the Coal-measures, representing such genera as *Psammodus*, *Psephodus*, *Helodus*, and *Ctenoptychius*. Fossil teeth of these genera occur scattered rather sparingly through the mass; they are very perfectly preserved, and